The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 59
March 1924
No. 698

LONDON : PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

To be purchased through any Bookseller or directly from
H.M. STATIONERY OFFICE at the following addresses:
IMPERIAL HOUSE, KINGSWAY, LONDON, W.C.2, and 28, ABINGDON STREET, LONDON, S.W. 1.
YORK STREET, MANCHESTER; 1, ST. ANDREW'S CRESCENT, CARDIFF; 120, GEORGE STREET, EDINBURGH; or from THE METEOROLOGICAL OFFICE, SOUTH KENSINGTON, LONDON, S.W.7.

Progress in the Study of World Weather

DR. WALKER'S researches into the relations of weather in different parts of the globe are well known. The eighth of the series of memoirs* is devoted to an attempt to find the causal connection between variations of pressure and rainfall in different centres, in order to facilitate the discovery of methods of long range forecasting. All the work is carried out quantitatively by means of correlation co-efficients, and in the course of the paper nearly a thousand such co-efficients are introduced, so that the generalisations have a solid basis of facts.

The first chapter deals with solar relations. When Wolf's sunspot numbers are correlated with various meteorological elements some interesting relationships are found, but in the great majority of cases the co-efficients are small. The negative correlation between sunspots and temperature is found to persist, even when the effect of rainfall on temperature is allowed for. On the other hand the correlations between temperatures and the solar radiation measured at Mount Wilson are generally positive, and it appears that sunspots, although normally associated with increased radiation, also have the effect of increasing the opacity of the atmosphere towards solar radi-

* Correlation in Seasonal Variations of Weather, viii. A preliminary study of World Weather. By G. T. Walker, F.R.S., *Ind. Met. Mem.*, Vol. xxiv., part iv., Calcutta, 1923.

Wt 69—P 1 1000 3/24 M & C

ation, and hence the maximum temperatures are lowest at spot maxima. It is admitted that further data are required to support this conclusion.

Variations of solar radiation are however found to be quite inadequate for explaining the seasonal abnormalities of the weather, and in the later chapters the explanation is sought in the previous distribution of seasonal features over the earth. For this purpose the quarterly means of pressure (December to February and June to August) are found for each year at fourteen "action centres," and in addition the seasonal rainfall at seven "precipitation centres." Each of these values is correlated with all the others, not only for the same season, but for two quarters before and two quarters after, and in special cases a number of additional co-efficients are calculated. The generalisation which emerges from this mass of detail is that there are two areas, the first including America, the Pacific Ocean and the Azores, and the second the Indian Ocean, Australia, Asia and Iceland: the members of each group have positive correlation of contemporary pressure with the members of the same group, and negative correlation with the members of the other group. "There is a swaying of pressure on a big scale backwards and forwards between the Indian Ocean and the Pacific Ocean, and there are swayings on a much smaller scale between the Azores and Iceland and between the areas of high and low pressure in the North Pacific; further, there is a marked tendency for the 'highs' of the last two swayings to be accentuated when pressure in the Pacific is raised and that in the Indian Ocean lowered."

The two areas are similar to those found by Prof. T. H. Bigelow to have opposed or direct relations to the area of solar prominences. Since direct solar influences have already been ruled out, this similarity must mean that "variations of world weather tend to occur in a definite manner, *i.e.*, to be associated with definite swayings or surges of pressure, and that changes in solar conditions tend to favour or check these weather changes."

What is the immediate cause of this swaying of pressure? Variations of temperature are found to be a result and not a cause; variations in the intensity of the atmospheric circulation may have something to do with it, but the main cause, as regards the southern hemisphere at least, is found in the Antarctic. There appears to be a marked negative correlation in winter between pressure in the Antarctic, near Snow Hill, and in South America, so that when pressure in the Antarctic is low pressure in South America is high. At this stage we must turn aside for a moment to consider the oceanic circulation in the southern hemisphere. This is mainly counter-clockwise round the edges of the basins, *e.g.*, from the neighbourhood of Cape Horn one current travels eastward in the Southern Ocean to South Africa

and Australia, sending a branch, the cold Benguela current, northward along the west coast of Africa, while another, the Humboldt current, travels northward along the coast of Chile, turning westward, as the south Equatorial current, and reaching Samoa and finally eastern Australia. When pressure in South America is high, the temperature near the South Orkneys is high, and the eastward current from the region of the South Orkneys will be less cold than usual and will bring lower pressure along with it. This wave of low pressure will in time reach Cape Town, Mauritius, and south-east Australia, and its progress is followed by means of correlation co-efficients. From South America to Cape Town the wave takes about six months, and it takes about the same interval from South America to Mauritius, so that the two latter appear to be on different parts of the same wave front instead of being connected in series. From Mauritius to Australia the interval is one or two months.

Returning to South America, we find that when pressure is high there, the cold Humboldt current will be strengthened, and a wave of high pressure will travel westwards from South America, reaching Samoa nearly a year later, and south-east Australia in another three months. Thus the opposition between the pressure changes in the Indian and Pacific oceans is mainly due to the propagation of waves of pressure of opposite signs eastward and westward from South America and the regions south of it. The objection that such pressure waves would be rapidly damped out is met by supposing them to be amplified by the changes of pressure associated with monsoon rainfall in India and Australia, and possibly also by further influences from the Antarctic. The connection between the solar prominences and these Antarctic influences we are left to infer. The effect of heavy rainfall from an air current crossing any region on the subsequent rainfall of other regions in the path of the air current, owing to changes in the lapse rate and in the surrounding pressure distribution, is also discussed in some detail. The general result seems to be that the causal connection between weather in successive seasons in different parts of the world present an adequate explanation of most of the seasonal abnormalities. Although the paper is termed a "preliminary study," and the influences dominating Indian monsoon rainfall are specifically left for future discussion, the work is rich in suggestions. For example, it is pointed out how the method of forecasting adopted by Braak,* in Java, could be simplified and improved, and the thorough groundwork laid down will prove invaluable to all interested in long range forecasting.

C.E.P.B.

* See *Meteorological Magazine*, Vol. 55, 1920, *p.* 205.

Discussions at the Meteorological Office

February 18th, 1924. *On the nature of atmospherics.* By R. A. Watson Watt and E. V. Appleton (Proc. Roy. Soc., Vol. 103, 1924, p. 84). *Opener*—G. I. Taylor, F.R.S.

The paper by Messrs. Watt and Appleton, which formed the text for this discussion, was reviewed in the *Meteorological Magazine* last April. It will be remembered that the first fruits of the use of the cathode ray oscillograph in the study of atmospherics were set out. In the oscillograph or as we should prefer to call it, the oscilloscope, there is a stream of electrons impinging on a fluorescent surface. Movements of the point of impact are produced by changes in the electric forces that act on the stream. By connecting one pair of terminals of the oscilloscope to a circuit in which regular electric vibrations can be produced the luminous spot on the fluorescent surface is drawn out into a line. When another pair of terminals is connected to an aerial the spot is sensitive to electric waves coming from a distance. Such waves give it a movement at right angles to that produced by the local oscillator and instead of a straight line a curve is seen. As was pointed out by Professor Taylor, curves such as are reproduced in the paper are not always easy to interpret : they flash out apparently instantaneously and there is no direct evidence as to which is the beginning and which the end of the incoming wave.

Dr. Appleton and Mr. Herd, who took part in the discussion, were able to report that great progress had been made during the months that had elapsed since the paper was published. The difficulty of interpretation has been got over by an ingenious alteration in the oscillating system which controls the persistent movements of the luminous spot. Instead of moving right and left in simple harmonic motion like a pendulum bob, the spot has been made to move comparatively slowly in one direction and to return a hundred times as fast in the opposite direction. (An analogy may be found in the quick process of pumping up a tyre and the slow process of emptying it through a very small puncture or other slow leak, but in the electric system, pumping takes ·0001 of a second, emptying ·01 of a second) By this device the interpretation of the pictures seen in the oscilloscope has been greatly facilitated as a transient curve is only visible during the comparative slow left to right movement.

Perhaps the most important result is that it has become possible to distinguish between the dynamical and statical effects of the electrical disturbances. If a log were to be dropped into a well-filled bath a water-level recorder would show first the waves, then a semi-permanent change of level and then a gradual return to the original level as the water escaped through

the overflow pipe. In somewhat like manner the oscilloscope permits distinction between the change in electric field due to a comparatively near lightning flash, and the electro-magnetic wave radiated as the result of such a flash occurring at a much greater distance. It is now possible to recognise from the curve seen in the oscilloscope whether a particular atmospheric is due—

(A) To the nett change of field caused by lightning within a few hundred miles, or

(B) To the true radiation propagated from lightning occurring, say, in Equatorial regions, or

(C) To a combination of both cases, a discharge at an intermediate distance.

The apparatus as constructed at present is not safe for use when thunderstorms are near by. It is hoped that before long, it will be possible to investigate the variations of electric potential produced by lightning in the immediate neighbourhood, and so bring this work into line with Mr. C. T R. Wilson's*. The vexed question whether clouds with positive and negative "polarity," *i.e.*, with + charges above and − charges below and *vice versa*, are both possible, will then be settled. Dr. Appleton gave it as his opinion that all atmospherics were due to lightning: the most prolific sources of atmospherics were certainly in the tropical belt and the diurnal variation in the strength and bearing of these electric waves could be explained by the variation in the frequency of thunderstorms throughout the day.

From the meteorological point of view this is perhaps a little disappointing. If atmospherics are merely broadcasted news of the occurrence of thunderstorms it is hardly likely that they will serve as the key to the mysteries of the weather. At the same time, the ability to distinguish between the fields due to local and remote discharges will surely prove of considerable meteorological value.

March 3rd, 1924. *Der tägliche Gang der Temperatur in der freien Atmosphäre über Lindenberg.* By H. Hergesell (Braunschweig, Die Arb. der Preuss. Aero. Obs. bei Lindenberg, XIV Band). *Opener*—Capt. D. Brunt, M.A., B.Sc.

The observations of upper air conditions at Lindenberg, the aerological research station near Berlin, form a unique series, daily kite ascents having been made almost without a break since 1905. To ensure a good distribution of observations and provide information as to diurnal variations, an ingenious timetable was adopted for two years, from May 1917 to June 1919, the hours of the ascents moving on from day to day. Professor

* *Met. Mag.*, Vol. 55, Dec., 1920, p. 243.

Hergesell has determined the average temperature for each hour of the day in summer and in winter at various heights up to 5,000 metres. To compensate for the comparatively small number of observations, a few hundred at each hour, the readings at successive levels are correlated and the means are adjusted by comparison with the continuous records made at the observatory. Finally the hourly values are smoothed by harmonic analysis. The results are striking. In summer the type of diurnal variation with which we are familiar, the highest temperature in the afternoon, the lowest at sunrise, persists up to about 2,000 metres; above this level there is one maximum only, at noon. It is found that for about 4 hours a day the average lapse-rate in the lowest kilometre is in excess of the adiabatic rate, 10°C. per kilometre. At higher levels it is hottest at noon, coldest at midnight, the range is small, however, only 3°F.

In winter conditions are much more complicated; at the higher levels there are three maxima and three minima in the 24 hours. Much work has been devoted to the search for an explanation of this curious phenomenon. It appears that there is a corresponding oscillation in the upper winds and that the fact that air coming from the south is warmer than wind from the north will account for the observed changes of temperature.

As was pointed out by Captain Brunt, this theory requires the support of more direct observations, such as could be obtained by keeping a kite at the same height for several days. In the discussion doubt was expressed as to whether the material available for the determination of diurnal variations of temperature had been subdivided enough. The results given for summer and winter did not support each other. It would have been more satisfactory if four seasons had been taken so that any progressive change of type could have been traced.

Perhaps the most important result of the whole investigation is that the regular temperature changes in the middle atmosphere are small, insignificant in comparison with the changes from day to day. For establishing this result Dr. Hergesell merits our thanks.

The subjects for discussion for the last two meetings of the session will be:

March 17th, 1924. *An aerological survey of the United States. Part I., Results of observations by means of kites.* By W. R. Gregg (M.W. Rev.: Supplement No. 20, Washington, 1922). *Opener*—L. H. G. Dines, M.A.

March 31st, 1924. *Radiative equilibrium: the insolation of an atmosphere.* By E. A. Milne (Phil. Mag., Vol. 44, 1922, p. 872). *Opener*—M. A. Giblett, M.Sc.

Royal Meteorological Society

THE monthly meeting of the Society was held on Wednesday, February 20th, at 49, Cromwell Road, South Kensington, Mr. C. J. P. Cave, M.A., J.P., President, in the Chair.

Prof. S. Chapman, F.R.S.—The lunar atmospheric tide at Mauritius and Tiflis.

The following is an abstract—The moon is known to produce a tide in the atmosphere which reveals itself by a small semi-diurnal variation of barometric pressure during each lunar day. The range of this pressure oscillation is small, and can only be determined by computation from long series of records. In previous papers the results of such calculations have been given for Greenwich, Aberdeen, Batavia and Hongkong. The investigation has been continued because the phase of the tide is found not to have the value which would be expected (corresponding to high pressure nearly at upper and lower transit of the moon) but to vary with the station and also with the season. The present paper adds two new determinations to those already mentioned. It appears to be too early as yet to form definite conclusions as to the cause of the irregularities of phase which are revealed.

Prof. S. Chapman, F.R.S.—The semi-diurnal oscillation of the Atmosphere.

This paper deals with the cause of the atmospheric oscillation which manifests itself in the semi-diurnal variation of barometric pressure. The magnitude of this variation and its regularity of occurrence over the greater part of the globe, support the view which Kelvin first suggested, and which has received confirmation from the calculations of Margules, Hough and Lamb, that the oscillation is magnified by resonance, its period of twelve solar hours being in near agreement with a period of free oscillation of the atmosphere. It has remained an open question, however, whether the oscillation was mainly caused by the daily heating and cooling of the atmosphere, or whether the sun's gravitational influence also played an appreciable part in the phenomenon. This uncertainty rendered it difficult to explain, even roughly, the observed phase of the oscillation. In the present paper an attempt is made to estimate the relative importance of the two causes, assuming that the semi-diurnal changes of temperature in the lower atmosphere are mainly due to the thermal conduction upwards from the ground. The result is somewhat indefinite, not because of mathematical difficulties, but chiefly owing to the scarcity of reliable data concerning the semi-diurnal variation of temperature, and the eddy conductivity, over large parts of the earth. It seems not unlikely, however, that the sun's thermal and gravitational

influences are about equally responsible for the oscillation, and on this hypothesis the observed phase of the oscillation can be accounted for fairly well. The magnitude of the oscillation indicates that the approximation of the adjacent free period to twelve solar hours must be very close, that is, to within a few minutes: this is much nearer than existing theories of atmospheric vibrations can account for.

C. S. Durst, B.A.—The relationship between current and wind.

A large number of observations made by ships at sea are examined in the light of Ekman's theory of ocean currents. It is found that the theory is borne out by the average direction of flow, and that the average velocity of current is directly proportional to the speed of the wind. From Jeffreys's work on the theory of turbulence as applied to the ocean, coefficients of turbulence are deduced for various regions of the seas.

Correspondence

To the Editor, *The Meteorological Magazine*

Weather and Magnetic Character

THE reference, on p. 10 of the *Meteorological Magazine*, February, 1924, to the concluding remarks in my recent address to the Royal Meteorological Society does not seem to present my argument altogether correctly. The argument used was as follows:—

The terrestrial element that shows most unmistakably the sunspot (11-year) period is Terrestrial Magnetism. It is the range of the regular diurnal variation, which is much enhanced at sunspot maximum, which shows the sunspot relation most clearly. Now this enhancement of the regular diurnal variation is also exhibited during magnetic disturbance, and is then very large indeed in high magnetic latitudes. The cause of the enhancement in either case is believed to be increased ionisation of the atmosphere due to radiation of some kind from the sun. It is thus reasonable to regard magnetic disturbance as associated with the presence of some at least of the atmospheric conditions normal to sunspot maximum. This suggests that even on the side of meteorology days of high magnetic disturbance may differ from magnetically quiet days in the same way as days near sunspot maximum differ from days near sunspot minimum. A comparison of meteorological phenomena on magnetically disturbed and quiet days might thus prove a useful auxiliary in the investigation of the relation, if any, between meteorology and sunspot frequency.

C. CHREE.

Kew Observatory, February 21st, 1924.

A Cloud Pendant

On March 31st, 1923, I, my wife and daughter saw from here what we thought was a " Waterspout," about two to three miles south-west. It was prolonged as an elephant's trunk and " felt about " in the same way as the animal's trunk does. I should estimate that the diameter was from 50 to 100 yards and that the trunk came within, say, 200 feet of the ground.

The spout gradually came down from a dark horizontal narrow streak in the larger cloud. We could see a revolving inside the trunk which seemed to be sucking air, leaves and dust upwards It was apparently not emitting water. The trunk gradually drew up into the darker horizontal streak and the whole heavy cloud passed north-westwards. There was only ·04 inch of rain here with thunder.

Would this be a cyclone in miniature ? I heard of no damage done or anyone else who saw it. The shape of the pendant was like that shown in Fig. A of the plate facing page 281 of the *Meteorological Magazine* for January, 1921. The volute of Fig. B did not occur.

A. E. Christy.

Wellmead, Fryerning, Ingatestone, Essex, January 6th, 1924.

A Northerly Weather Type

The weather changes described by Mr. Edwards in the following letter occurred during a day when an unstable current of air which had come from the neighbourhood of Iceland covered most of the United Kingdom. Heavy showers were reported at many places.

A brisk fall in the barometer set in about midnight on the 23rd, the wind increased quickly from WNW to force 6 about 5h. on the 24th with intermittent rain and cumuliform stratus moving from WNW at about 2,000 feet. At 9h. 30m. the low cloud sheet commenced to break and large cumulus clouds were revealed at about 5,000 feet, moving from NW'N. The forenoon continued mainly cloudy or overcast with a slight decrease in the force of the wind to force 5 and occasional showers of slight rain. Observations of upper cloud motion showed a veer to NNW at about 20,000 feet. Much false cirrus could be seen to the northwards about noon but no true cumulo-nimbus was detected. Low cloud increased again after 13h., being somewhat ragged and irregular in shape. Temperature reached its diurnal maximum (44°F.) at 14h. 40m.

The sky to the north-east became decidedly gloomy about 14h. 30m. and this appearance persisted. To north-westwards the low clouds were patchy and revealed yellowish masses of false cirrus at a decidedly lower elevation than usual. The surface wind was north-westerly at 15h. force 5, and the low

cloud motion was unchanged. The gloom to the north-east increased at 15h. 10m. a film of smoky nimbus at about 1,000 feet spread rapidly in from north-east. Surface wind shifted quickly through N to NE without any great change in velocity. Rain commenced immediately before the wind shift, after which it turned to small sleet and soft hail, being rather violent. The fall continued for about 15 minutes, being very mixed in character, some large wet flakes of snow being observed towards its close. An aneroid barometer showed a rise immediately after the wind shift and temperature fell 3°F.

At 16h. 15m. the sky was almost clear, and the wind had backed to WNW and fallen to force 2. To the west and south west extending to about 20° above the horizon were some highly picturesque masses of cumulo-nimbus with very contorted false cirrus at their summits. They were moving rather quickly south.

At 17h. there was evidence of a subsidiary squall. The surface wind fell to almost calm—it was south for a few moments and then at 17h. 10m. there was a sudden gust (force 4) from N. This settled down into a steady breeze which lasted for the rest of the evening. Fracto cumulus appeared to be associated with this squall and a few moderate sized patches formed very quickly. Their motion was from NNE, and their elevation was estimated at 3,000 feet.

FRANK EDWARDS.

177, Clarenden Road, Whalley Range, Manchester, February 26th, 1924.

Wind and Weather

IN the *Meteorological Magazine* for January, 1924, page 285, there is a short review of the little book on "Wind and Weather."

In speaking of Skiron—the north-west wind—the types have made what was written "his husky Highness" into "his dusky Highness." Unintentionally they have changed the complexion of the north-west wind. There are different meanings for the word "husky"; but a common usage in America is strong, robust, vigorous; and it was used in this sense to characterize Skiron.

We did say that, as the lord of hot air, "his husky Highness might not inappropriately adorn legislative halls and editorial sanctums"; but we should have been more explicit; for this may not hold for *all* editorial sanctums.

ALEXANDER MCADIE.

Blue Hill Observatory, Readville, Mass., U.S.A., February 4th, 1924.

[We tender apologies to Prof. McAdie for the misquotation. His note has led us to consult the dictionaries. In the New English Dictionary there is a quotation from Lisle's Husbandry of the year 1722. "We had also for the most part very dry

husky winds." The usage mentioned by Prof. McAdie is to be found in Webster's Dictionary with the qualification "Colloq. U.S.," and also in Farmer and Henley's Dictionary of Slang and Colloquial English (1905), where it is described as an adjective meaning stout, well built. There is no mention of it in the Dictionary of Americanisms by J. S. Farmer, which was published in 1889, but Thornton's American Glossary, 1912, defines it as rough and sturdy, and quotes from the New York Evening Post, 1910, "as husky as a buffalo."—Ed. *M.M.*]

NOTES AND QUERIES

Simultaneous Rain and Fog

Fog and drizzle are frequently associated, but in London it is rare for appreciable rain to be simultaneous with dense fog. On Sunday, December 30th, 1923, rain commenced at Chiswick, in the West of London, about 11h. After half an hour, fog came on suddenly ; at the worst, the range of visibility of objects such as trees was about 60 yards : the improvement was gradual, but it was still raining when the fog had gone. The rate of rainfall at South Kensington was about 1·5 mm. per hour ; as the fall was very steady the rate at Chiswick must have been nearly the same.

Cloud and Fog in the Desert

Observations made at the auxiliary stations associated with the Observatory at Arequipa, in Peru, during the years 1896 to 1900, have been published as Vol. 86, Part 3, of the Annals of the Astronomical Observatory of Harvard College. For one of the stations, La Joya, near the centre of the Desert of Islay, the total rainfall for the five years is given as 0.21 inch, the wettest month having 0·04 inch. Nevertheless the sky during the summer months is often cloudy ; in the average January the evening observations include clear sky on six occasions, fair on seven, and cloudy on eighteen. A few observations were also made at Cachendo, on the southern edge of the desert, to see if better conditions for astronomical work could be found there. Cachendo is at 3,250 ft., and about 10 miles from the Pacific. This station was found to be subject to fog ; on one occasion the observer reported "From the hill south of the hotel, I watched the fog come up from the sea. It appeared just before sunset, filling at first the lower valleys and ravines and then rushing past me like a race horse, so that in less than 10 minutes the entire pampa as far as I could see was filled with it."

Pilot Balloon Observations at Barcelona

RAPID progress has been made recently in the publication of the pilot balloon ascents made at Barcelona.* Two details catch the eye. The routine of the observations is so arranged that the balloon ascends at 2 metres a second and readings are made at intervals of 50 or 100 seconds. As the wind speed is to be found in metres per second, the simplification in the arithmetic as compared with that in the English method of observing at every minute is appreciable. In the tabulation of the results the mean wind for each interval of 200 metres is set down, not the wind *at* particular levels. Bigger steps, 250 or 300 metres, are shown in the later tables.

In the individual ascents, large variations of wind direction in the lowest kilometre are found as a general rule. The longest set of observations in the collection was made on November 21st, 1922, when the balloon was kept under observation for about 3 hours. As is pointed out in a prefatory note, the assumption of a uniform rate of ascent is misleading in such a case.

There are two records of dead calms reaching to considerable heights. On June 25th, 1923, at 7h. 15m. the calm extended to 900 metres; on June 28th, at the same hour, to 600 metres. On the former occasion the upper wind was from the north, on the latter occasion it was from west; the average strength of the current between 600 metres and 900 metres was 10 miles an hour. Perhaps some reader can give details of other noteworthy calms.

The Dry Winter of 1922-23 in Spain

IN the same series of publications† a note by Gabriel Campo on the characteristics of last winter has been issued. The note contains some interesting and novel composite charts on each of which the position of the 1014 mb. isobar is shown for every day of a month. On the chart for January, 1923, there is a tangle of lines over north-west Europe and another round the Gulf of Lions, but only two lines enter Spain, which was persistently within the ambit of the Azores anti-cyclone. The November chart has a conspicuous tangle about the Straits of Gibraltar to mark the occurrence of low pressure in that region. The rainfall of the four months, November, 1922, to February, 1923, at Barcelona was 51 mm. as compared with 370 mm. in the same months of the previous winter.

---

* SERVEI METEOROLÒGIC DE CATALUNYA: NOTES D'ESTUDI. Nos. 19, 22, 25 and 28. Barcelona, 1923.

† SERVEI METEOROLÒGIC DE CATALUNYA: NOTES D'ESTUDI. No. 21. Barcelona, 1923.

The Observatories on Mont Blanc

IN an article printed in the *Times* of March 4th, Dr. A. E. H. Tutton gives an account of the observatories erected on Mont Blanc. There have been four. The first, which was constructed on the Col des Bosses by M. Vallot in 1890, was eventually buried to the roof in snow, and was abandoned in 1898, when M. Vallot erected his present observatory on the Rocher des Bosses 14,312 ft. above sea level. After 25 years this observatory still defies the tempests and the snows. The veteran scientist has made 35 expeditions to the summit and to his observatory, and still takes the liveliest interest in the scientific memoirs, now over a hundred in number, which record the results of the observations.

In the year 1890 Dr. Janssen visited the first observatory, and in spite of warnings from M. Vallot, who pointed out that one cannot establish anything on a snowfield, persisted in erecting an observatory on the unfathomable* snow of the summit itself. This observatory was constructed in 1893; by 1908 it had disappeared under the snow. A considerable portion of the woodwork was dug out and it is now being used up as fuel at the Vallot observatory. The loss of the summit observatory was much regretted, and M. Vallot acceded to a request to erect a very light one to replace it, but with the warning that the place would not form a safe shelter in thunderstorms. The warning was tragically verified in 1910, for a party engaged in observing was surprised by a thunderstorm and one of the party was killed by lightning. The following summer this structure was partly buried and " the pure white dome of snow is now unsullied and free."

Weather and History

THE many who work at routine meteorology, observing, computing and so on, and who feel, perhaps, that the scientific value of the work is not sufficient recompense, may be stimulated by the views of a modern historian. At the meeting of the Society of Bookmen on November 6th, Mr. Philip Guedalla, speaking of the writing of history, laid great stress on the necessity for making it readable. Weather, he said, was a necessary and neglected detail. It was necessary not only as a causative factor but also as a part of the picture. " If you want to make a man see and feel an incident tell him what the weather was like." He continued that the research involved must be accurately carried out, as there is a distinct danger of over-statement. It is difficult not to choose the most effective weather as a background. He

* Unfathomable is Dr. Tutton's word. It tempts us to ask whether the snow *has* been fathomed.

cited an instance in his own experience, when, wishing to find that a certain night in Paris was foggy, he searched the records vainly for even a mist!

This appreciation of meteorology by the historian is encouraging in two ways. It suggests much useful and very pleasant work to be done in old records on the lines of, say, Lowe's *Chronology* or "*Weather in War-Time*," by Richard Bentley, F.S.A.,* and it puts modern work in a new perspective. To regard year books, lustrum sheets, pocket registers and suchlike as some material for history and letters is a pleasing viewpoint for those who cannot reach the heights where new theories and other rare plants flourish. D.F.

The Green Auroral Line in the Laboratory

According to newspaper reports Professor Vegard, working in the Laboratory of Professor Onnes, at Leyden, has succeeded in obtaining the green auroral line. Nitrogen was cooled until solid particles were produced, and these were submitted to electrical radiation (presumably to bombardment by cathode rays). The light emitted was no doubt examined in the spectroscope, and showed the green line hitherto seen only in aurora. The confirmation of Vegard's hypothesis that nitrogen existing in a solid form in the upper atmosphere would account for the characteristic structure of aurora is very gratifying.

In view of the misleading phraseology of some popular accounts of these experiments it should be emphasized that the hypothesis is that the nitrogen is in the form of minute molecular aggregates, microscopic or ultra-microscopic crystals, and that the atmosphere from 100 kilometres above the earth to the upper limit of the aurora, say, 500 kilometres, consists in the main of such particles. Journalists have referred to the nitrogen as solidified by contact with the cold of outer space, and suggested that the temperature is the absolute zero. Actually, the temperature at which nitrogen freezes is about 63°A. The hypothetical particles are at night receiving radiation from below; the heat rays from the earth itself cannot get through to them; most of the radiation they receive must proceed from the stratosphere: thus, the persistence of the particles would seem to indicate that the heat they radiate in all directions at such a temperature as 63° balances the heat they receive (on one side) from a source at about 220°. The possibility of thermal equilibrium being attained in such a way will no doubt be investigated experimentally.

It is of interest to remember that the Aitken nuclei on which vapour condenses to form clouds are thought to be molecular aggregates or ultra-microscopic crystals, the principal constituent

* *Q.J.R. Met. Soc.*: Vol. xxxiii., April 1907, p. 81.

of which is sea-salt. Vegard's nitrogen particles would seem to be of the same order of magnitude. There is, however, a great difference between the two cases. The Aitken nuclei are supported by the viscosity and turbulence of the air. Vegard's particles are supposed to be kept up by electric forces, and physicists find this part of the theory most difficult to accept.

Soaring Flight

Some account of the discussion of Dr. Hankin's observations of the soaring flight of birds, dragonflies and flying fish has been given in previous numbers of the *Meteorological Magazine.** On November 9th Dr. Hankin gave an address on the same subject before the Institution of Aeronautical Engineers in which he dealt with some of the phenomena which accompany soaring flight, the musical whirring sound made by vultures and cheels while soaring, the distortion and change of colour of the wings of soaring birds, etc. But the main subject of the address was the occurrence of steep upward glides without apparent loss of speed. These he had observed frequently but found very difficult to explain as they appeared to occur only on occasions when there were grounds for suspecting that the bird was in a descending current.

In one of his earlier papers† Dr. Hankin stated that soaring flight was due neither to undiscovered wing movements nor to the use of ascending currents. Now, however, he had arrived at the conclusion that soaring flight in descending currents is due to the mixing of ascending and descending masses of air or at least to some kind of turbulent motion. Observations by Mr. J. D. North and experiments by Dr. Betz of Göttingen had helped him to reach this conclusion. Mr. North had observed, from the stern of a steamer, pieces of paper that he had thrown overboard rising continuously when enveloped in dilute descending smoke. That is to say, there was an admixture of ascending air that carried the paper with descending air that carried the smoke particles. According to Dr. Betz such opposed movements can do more for the soaring bird than could the ascending component only. It is in these opposed currents that the bird shoots upwards almost as if fired out of a gun, its course making an angle of between 30° and 80° with the horizon in the case of gulls.

A further point that Dr. Hankin makes is that " the presence of wind seems necessary to permit the development of a soarable area at the stern of a steamer. In the absence of wind there is still a relative wind caused by the movement ahead of the steamer

* Vol. 56, p. 43, Vol. 57, p. 19, and Vol. 58, p. 62.
† *Cambridge, Proc. Phil. Soc.*, Vol. xx., Part iv., p. 460.

and presumably a descending current at the stern. But under such conditions no soarable area is formed. Gulls following the steamer do so by flapping flight." Moreover some winds, though fitted by their force and direction to aid mixing of ascending and descending air masses in the descending current at the stern, do not permit the appearance of a soarable area. It is noteworthy that Dr. Hankin does not appear to have considered the relation of "soarability" to temperature. The growth of the effective eddies will probably depend on whether the air is being cooled or heated by the water it is passing over.

Temperature in Mexico

A VERY full discussion of the temperature of Mexico, by Jesus Hernandez, B.C.E., has been published* by the Weather Bureau of the United States. The observations utilised were made at 70 meteorological stations, and the averages refer to the period from 1901 to 1910. [Perhaps the shortness of this period may be accounted for by political circumstances. Whitaker tells us that President Diaz ruled (except during 1880-4) from 1876 to May 25th, 1911, and that since the fall of Diaz internal disturbances in which eleven Presidents have figured have continued with varying degrees of intensity.]

There are no less than 75 excellent maps. Amongst the most striking are those showing the month to month differences in mean temperature. For example, comparison between May and June shows that on the northern border the latter month is the warmer by 4°C.; on the southern shores of the Gulf of Mexico the two months have the same temperature and on the other side of the isthmus June is colder than May by 1·5°C. Credit must be given to Mr. W. W. Reed of the Weather Bureau for the smooth English of the translation. The report, which is published at the modest price of 10 cents, should be studied by all who are interested in the climate of North America.

The Effect of a Protecting Wire Cage upon Readings of a Grass Minimum Thermometer.

THE observers at several stations have found it necessary to place a wire cage over the grass minimum thermometer in order to protect it against stray tennis balls, thrown stones or prowling animals. It having been suspected that the use of such a cage affected the thermometer readings, an investigation was started at Kew Observatory.

* *Monthly Weather Review.* Supplement No. 23, 1923.

The method adopted was as follows: Three grass minimum thermometers were similarly exposed on the lawn. One was left unprotected. The second was protected by a wire cage 20 inches long, 10 inches wide and 7 inches deep, of which the diameter of the meshes was about 1 inch; the diameter of the wire used was 0·1 inch. This cage rested directly upon the grass. The third thermometer was protected by an exactly similar cage, which, however, was to some extent thermally insulated from the ground by standing upon four wooden feet projecting about an inch above the ground. The three thermometers were read and set daily from January 25th to April 30th, 1923, and, in order to eliminate any individual peculiarities of the thermometers, they were regularly interchanged so that an approximately equal number of observations were obtained from each thermometer in each of the three positions.

If the letter A be used to designate the readings of the thermometer under a cage without insulation, B the readings of the thermometer under a cage with insulation, and C the readings of the thermometer without a cage, then the means of the readings obtained in the different positions are as follows:—

	Average Readings.			Differences	
	A	B	C	A—C	B—C
All nights (94)	35·2	35·0	34·2	1·0	0·8
Nights of Frost (29) ...	28·5	28·1	26·7	1·8	1·4
Nights without Frost (65)	38·2	38·1	37·5	0·7	0·6
Nights of Clear Sky (20) ...	30·8	30·7	29·2	1·6	1·5
Overcast Nights (43) ...	39 3	39·2	38·5	0·8	0·7
Nights of Fog (20) ...	32·1	32·0	31·0	1·1	1·0
Nights of Rain (47) ...	37·6	37·3	36·7	0·9	0·6

When arranged in a series according to increasing readings of the exposed thermometers, the differences A—C and B—C generally diminish from averages of over 2°F. at low temperatures to about 0·2° F. at temperatures from 45° F. to 50° F.

The results suggest that on nights of strong outward radiation (or rather of weak inward radiation) the screening effect of the wire cage is considerable. On the other hand a comparison between these readings and the corresponding readings (S) of the minimum temperature in the screen shows that there is no well marked connection between variations of the ratio $\frac{A-C}{S-C}$ or $\frac{B-C}{S-C}$ and variations of S—C itself.

The matter is being further investigated; meanwhile it is clear that the effect of a cage of the kind described increases the reading of the grass minimum thermometer on the average by about 1° F., and on nights of frost by 2° F. or more. Such cages should, therefore, not be used if they can reasonably be avoided.

Review

The Fernley Observatory, Southport. Report and Results of Observations for the year 1922. By Joseph Baxendell.

Mr. Joseph Baxendell's report for the year 1922, has been issued recently. As usual the report contains much useful information such as is not published for any other part of the United Kingdom. An appendix is devoted to the hourly averages of the duration, amount and intensity of rainfall at Southport. It is found that the diurnal variation is well marked, much more so than in London or at Bidston Observatory. At Southport in the hour from 6h. 30m. to 7h. 30m. it rains on the average for 5·5 minutes but in the hour from 12h. 30m. to 13h. 30m. the average duration is only 3·8 minutes ; these are the extremes for the day.

Mr. Baxendell's work on periodicity continues. We quote from his report on the 3·1 year period in British weather :—

> "The computations needed for the investigation of meteorological periodicities of the order of a few years, occupied a good deal of Mr. Charles Baxendell's time during the year. Especial attention was devoted to the cycle of nearly 3·1 years, which had been regarded even by its principal discoverer, Dr. H. R. Mill, as being either a temporary, or else a rather complicated and elusive one. We find, on the contrary, that it is one of the most permanent air pressure and rainfall periodicities in this country : in the south of England it is also one of the most intense and important—in some counties, indeed, it probably has no equal. Its exact length appears to be 3·09 years, that value having been determined alike from over 90 years' observations of rainfall at Bolton, and nearly $1\frac{1}{2}$ centuries of air pressure records in London. Moreover, dividing each of those series of data into two equal halves, the amplitudes of the mean sine waves of the earlier and the later halves, are, in each case, nearly identical. The Southport half-century's rainfall data give practically the same phase-angle as the Bolton 90 years' figures (reckoned, of course, from a common starting point) ; and it is very interesting to find that the phases of both nearly coincide with those of the London, long, air pressure record, *inverted*. The rainfall maxima apparently *slightly* precede the air pressure minima—a very natural circumstance. At Southport, the full range or double amplitude of this periodicity amounts to 14 per cent. of the average rainfall. In southern England the term probably accounts for far more than this. When noticed by Dr. Mill and others, the variation was, however, being for some time greatly re-inforced by ' interference ' ; an opposite effect is in progress now."

News in Brief

Dr. W. G. Duffield, Professor of Physics at Reading University, has been appointed Director of the new Solarphysics Observatory which is being built on Mount Stromblo, 10 miles from the centre of Canberra, the new capital of Australia.

On February 19th, 1924, there was slight precipitation at 17h. in the form of ice crystals. These crystals, which could be examined as they rested on the sleeve of a coat, were between one and two millimetres in diameter and of various forms, such as have been illustrated in Bentley's microphotographs; the simple patterns, the hub and six spokes, predominated. It must be somewhat rare for a London observer to have the opportunity to enter the symbol $\leftarrow$ in his register.

On February 10th the Central Physical Observatory Leningrad (Petrograd) issued a chart covering practically the whole of Europe, and indicating the probable "barometric state" during the second part of the winter of 1923-4 (February to beginning of April). On it are shown the regions likely to be visited by the centres of cyclones and of anti-cyclones. The probable tracks of "coldwaves" are shown by arrows; "premature heat" and storm areas are also marked. It will be interesting to watch the fate of this ambitious forecast.

It is announced that the Deutsche Seewarte is to follow the English example and give up the monthly issue of charts of the North Atlantic. The latest information is to be incorporated in "Pilots," and an endeavour is to be made to issue these monthly.

The following note is gleaned from a review* of "Watch Dogs," a new book by Col. E. H. Richardson, the well known trainer. For blood-hounds, "the best scenting day is one on which evaporation is taking place slowly. A nice moist atmosphere with no wind and a fairly damp soil contribute to conditions whereby successful tracking can take place; when there is high wind or hot sun the trail very quickly becomes obliterated; and when the ground is very hard and dry it does not lie well."

It is interesting to note that these conditions agree generally with those given by W. H. Pick† for foxhounds. Capt. Pick found that the scent was best of all on frosty mornings.

---

* Published in the *Illustrated London News*, February 16th, 1924, p. 266.
† *Meteorological Magazine*, Vol. 57, 1922, p. 16.

Two new cases for the display of autographic records at the door of the Meteorological Office were brought into use on February 25th. The exhibits include, besides the autographic records of temperature, humidity, atmospheric pollution, etc., taken at South Kensington during the preceding day, climatological diagrams shewing the conditions during the previous and current week.

The Weather of February, 1924

WESTERLY winds and mild weather prevailed over the British Isles during the first week of February as an anti-cyclone lay off our south-west coasts, and depressions passed eastwards across Iceland to Scandinavia. The first three days of the month were fair, over 8 hours of sunshine being recorded at many places, but after this the weather became dull. A large depression which reached the British Isles from the Atlantic caused high southerly winds and gales on the west coasts on the 8th ; there was heavy rain locally in Ireland—57 mm. being recorded at Valencia, and 50 mm. at Dunmanway (Cork). From the 10th to the 14th part of the Atlantic low pressure area moved slowly across the Bay of Biscay and France while pressure remained high over northern Europe ; cold easterly winds prevailed over the British Isles bringing a decided fall of temperature. The winds increased to gale force locally on the 12th, 13th and 14th. From the 15th onwards high pressure was maintained westward of Ireland with cold winds varying between west and north. Periodically depressions moved southwards over Scandinavia and the North Sea causing snow and sleet over most of the United Kingdom, but bringing also at first a temporary slight rise in temperature, *e.g.*, temperature rose to 54°F. at Inchkeith on the 21st, and to 46°F. at Kew on the 24th and 29th. The depression on the 29th was very deep and high winds or gales were experienced in all parts of the kingdom. From the 11th onwards the weekly averages of temperature and sunshine were, with few exceptions, below the normal. On the 13th the maximum reading at Balmoral was only 30°F., and on several other days there were places at which the temperature did not rise above 31°F. or 32°F. At Rhayader on the 15th the minimum readings were as low as 15°F. in the screen and 8°F. on the ground. Rainfall was generally below the normal, it was unusually slight in the southern Midlands ; 0.5 mm. was the total precipitation for the month at Llanthony Lock (Gloucester), and 2 mm. at Bishop's Canning (Wilts).

In Europe the weather of February was marked by severe snowstorms, gales and avalanches. A hurricane of unusual violence swept across Vienna on the 3rd, causing considerable

damage to property and injury to people, and on the 5th a violent storm broke over Gibraltar early in the morning, when hail swept over the summit of the Rock making it look as if it were snow clad, a sight said to be unknown during the last half century. Snow fell to a depth of 3 ft. in parts of Umbria, and cases of death from cold were reported in Florence. Towards the middle of the month many disasters were caused by great avalanches in Austria. In the latter part of the month heavy snowstorms occurred in Berlin, and snow interrupted railway communication between Madrid and the north of Spain. In northern Europe the international ferry route between Denmark and Sweden was blocked with icefloes on the 2nd, and after the middle of the month traffic between Finland, Sweden and Denmark was impeded in all parts of the Baltic owing to the increase of ice. Some ports were closed to navigation, and at others, *e.g.*, Hangö, Abö, traffic was only carried on by means of ice breakers.

Many lives were lost and much damage to property resulted from a blizzard which visited the Middle West of the United States on the 5th and 6th. Chicago and Davenport were completely cut off from communication with the north and east. Near the beginning of the month an ice bridge formed with startling suddenness across the entire width of the St. Lawrence from Sillery Point, near Quebec, to Levis. The bridge was too insecure for regular traffic and broke after a day or two. It is said that such a bridge has not been formed for 25 years.

Reports from Australia show that further good rains have fallen over Victoria, and fairly general light rains in New South Wales and Queensland.

The special message from Brazil states that plentiful rains occurred in all parts, the monthly average being 39·5 mm., 76·7 mm. and 38·7 mm. above normal in the northern, central and southern districts respectively. Floods occurred in many places, chiefly in the central districts, and these had disastrous consequences in the State of Rio de Janeiro. Temperature continued above normal, 1°C. on the average in the north and centre. Owing to the floods and adverse weather the prospects of the coffee and cane crops are not good. The cotton crop in the north is, however, in fair condition. At Rio de Janeiro pressure was normal and temperature one degree below normal.

Rainfall February, 1924: General Distribution

England and Wales	43	per cent. of the average 1881-1915.
Scotland	60	
Ireland	56	
British Isles	50	

Rainfall: February, 1924: England and Wales.

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	·65	17	39	*War.*	Birminghm, Edgbaston	·59	15	35
Sur .	Reigate, Hartswood	·67	17	33	*Leics*	Leicester Town Hall	·61	15	...
Kent.	Tenterden, View Tower	·87	22	40	,, .	Belvoir Castle	·86	22	52
,, .	Folkestone, Boro. San.	·58	15	...	*Rut* .	Ridlington	·74	19	...
,, .	Broadstairs	1·10	28	74	*Linc*.	Boston, Skirbeck	1·05	27	72
,, .	Sevenoaks, Speldhurst.	·87	22	...	,, .	Lincoln, Sessions House	·77	20	53
Sus .	Patching Farm	·41	10	19	,, .	Skegness, Estate Office.	·80	20	52
,, .	Eastbourne, Wilm. Sq.	·67	17	30	,, .	Louth, Westgate	1·04	26	54
,, .	Tottingworth Park	1·18	30	50	,, .	Brigg	1·09	28	63
Hants	Totland Bay, Aston	·28	7	14	*Notts.*	Worksop, Hodsock	1·25	32	81
,, .	Fordingbridge, Oaklnds	·36	9	14	*Derby*	Mickleover, Clyde Ho.	·56	14	34
,, .	Portsmouth, Vic. Park.	·41	11	20	,, .	Buxton, Devon. Hos.	1·63	41	43
,, .	Ovington Rectory	·42	11	16	*Ches*.	Runcorn, Weston Pt.	·84	21	45
,, .	Grayshott	·77	20	30	,, ..	Nantwich, Dorfold Hall	1·11	28	...
Berks	Wellington College	·51	13	27	*Lancs*	Bolton, Queen's Park .	1·65	42	...
,, .	Newbury, Greenham	·55	14	25	,, ..	Stonyhurst College	1·38	35	41
Herts.	Bennington House	·83	21	52	,, ..	Southport, Hesketh	·76	19	36
Bucks	High Wycombe	·68	17	37	,, ..	Lancaster, Strathspey.	·62	16	...
Oxf..	Oxford, Mag. College	·24	6	15	*Yorks*	Sedbergh, Akay	1·25	32	28
Nor .	Pitsford, Sedgebrook	·51	13	31	,, .	Wath-upon-Dearne	1·15	29	70
,, .	Eye, Northolm	·65	17	...	,, .	Bradford, Lister Pk.	·89	23	38
Beds.	Woburn, Crawley Mill.	·48	12	33	,, .	Oughtershaw Hall	2·10	53	...
Cam.	Cambridge, Bot. Gdns.	·73	19	57	,, .	Wetherby, Ribston H.	...	...	...
Essex	Chelmsford, CountyLab	·65	17	...	,, .	Hull, Pearson Park	·95	24	57
,, .	Lexden, Hill House	·63	16	...	,, .	Holme-on-Spalding	1·12	28	...
Suff .	Hawkedon Rectory	1·19	30	78	,, .	Lowthorpe, The Elms.	1·71	43	94
,, .	Haughley House	1·22	31	...	,, .	West Witton, Ivy Ho.	·75	19	...
Norf.	Beccles, Geldeston	1·79	46	131	,, .	Pickering, Hungate	2·03	52	...
,, .	Norwich, Eaton	1·94	49	118	,, .	Middlesbrough	1·27	32	98
,, .	Blakeney	1·05	27	71	,, .	Baldersdale, Hury Res.	1·19	30	39
,, .	Swaffham	1·24	31	79	*Durh.*	Ushaw College	·86	22	54
Wilts.	Devizes, Highclere	·19	5	10	*Nor* .	Newcastle, Town Moor.	1·08	27	68
Dor .	Evershot, Melbury Ho.	·74	19	24	,, .	Bellingham Manor	1·05	27	...
,, .	Weymouth, Westham	1·15	29	53	,, .	Lilburn Tower Gdns.	·89	23	...
,, .	Shaftesbury, Abbey Ho.	·58	15	25	*Cumb*	Penrith, Newton Rigg	...	...	...
Devon	Plymouth, The Hoe	1·98	50	68	,, .	Carlisle, Scaleby Hall .	·76	19	34
,, .	Polapit Tamar	1·90	48	59	,, .	Seathwaite	2·20	56	19
,, .	Ashburton, Druid Ho.	2·71	69	57	*Glam.*	Cardiff, Ely P. Stn.	·71	18	24
,, .	Cullompton	·72	18	26	,, .	Treherbert, Tynywaun	·83	21	...
,, .	Sidmouth, Sidmount	1·12	28	45	*Carm*	Carmarthen Friary	·58	15	22
,, .	Filleigh, Castle Hill	·85	22	...	,, .	Llanwrda, Dolaucothy.	1·35	34	31
,, .	Hartland Abbey	·91	23	...	*Pemb*	Haverfordwest, Portf'd	...	...	...
Corn.	Redruth, Trewirgie	2·63	67	70	*Card*.	Gogerddan	·99	25	31
,, .	Penzance, Morrab Gdn.	1·57	40	47	,, .	Cardigan, County Sch. .	·91	23	...
,, .	St. Austell, Trevarna	2·33	59	61	*Brec*.	Crickhowell, Talymaes	1·50	38	...
Soms	Chewton Mendip	·60	15	18	*Rad* .	Birm. W.W. Tyrmynydd	1·74	44	33
,, .	Street, Hind Hayes	·35	9	...	*Mont.*	Lake Vyrnwy	·83	21	18
Glos..	Clifton College	·44	11	19	*Denb.*	Llangynhafal	·76	19	...
,, .	Cirencester	·71	18	31	*Mer* .	Dolgelly, Bryntirion	2·26	57	51
Here.	Ross, County Obsy.	·28	7	14	*Carn*.	Llandudno	·48	12	23
,, .	Ledbury, Underdown.	·42	11	23	,, .	Snowdon, L. Llydaw 9	3·50	89	...
Salop	Church Stretton	·44	11	20	*Ang* .	Holyhead, Salt Island.	·60	15	25
,, .	Shifnal, Hatton Grange	·69	17	43	,, .	Lligwy	·65	17	...
Staff.	Tean, The Heath Ho.	·92	23	46	*Isle of Man*				
Worc.	Ombersley, Holt Lock.	·43	11	26		Douglas, Boro' Cem.	1·03	26	32
,, .	Blockley, Upton Wold.	·87	22	38	*Guernsey*				
War	Farnborough	·50	13	24		St. Peter Port, Grange .	...	...	...

Rainfall: February, 1924: Scotland and Ireland

CO.	STATION.	In.	mm.	Per-cent. of Av	CO.	STATION.	In.	mm	Per cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	1·03	26	39	*Suth.*	Melvich School	3·78	96	126
,,	Pt. William, Monreith	·92	23	...	*Caith*	Loch More, Achfary	8·37	213	127
Kirk.	Carsphairn, Shiel.	2·63	67	...	,,	Wick	2·25	57	99
,,	Dumfries, Cargen	·61	15	16	*Ork*	Pomona, Deerness	3·39	86	113
Dum	Drumlanrig	·65	17	17	*Shet*	Lerwick	3·99	101	126
Roxb	Branxholme	1·02	26	39	*Cork*	Caheragh Rectory	2·37	60	...
Selk	Ettrick Manse	1·36	35	...	,,	Dunmanway Rectory	3·40	86	58
Berk	Marchmont House	1·36	35	65	,,	Ballinacurra	2·11	53	56
Hadd	North Berwick Res.	·78	20	50	,,	Glanmire, Lota Lo.	2·79	71	71
Midl	Edinburgh, Roy. Obs.	·61	16	39	*Kerry*	Valencia Obsy.	3·56	91	68
Lan	Biggar	·69	17	29	,,	Gearahameen	3·50	89	...
Ayr	Kilmarnock, Agric. C.	·94	24	33	,,	Killarney Asylum	3·21	81	61
,,	Girvan, Pinmore	1·27	32	30	,,	Darrynane Abbey	2·09	53	45
Renf.	Glasgow, Queen's Pk.	·51	13	17	*Wat*	Waterford, Brook Lo.	1·49	38	46
,,	Greenock, Prospect H.	1·16	29	21	*Tip*	Nenagh, Cas. Lough	1·45	37	46
Bute	Rothesay, Ardencraig	1·38	35	35	,,	Tipperary	2·21	56	...
,,	Dougarie Lodge	1·22	31	...	,,	Cashel, Ballinamona	1·63	41	51
Arg	Glen Etive	...	...	...	*Lim*	Foynes, Coolnanes	1·83	47	57
,,	Oban	1·29	33	...	,,	Castleconnell Rec.	1·49	38	...
,,	Poltalloch	2·00	51	48	*Clare*	Inagh, Mount Callan	2·50	63	...
,,	Inveraray Castle	2·46	63	36	,,	Broadford, Hurdlest'n.	1·76	45	...
,,	Islay, Eallabus	2·33	59	56	*Wexf*	Newtownbarry	1·56	40	...
,,	Mull, Benmore	...	...	...	,,	Gorey, Courtown Ho.	...	...	...
Kinr.	Loch Leven Sluice	1·17	30	41	*Kilk.*	Kilkenny Castle	1·49	38	59
Perth	Loch Dhu	2·70	69	36	*Wic*	Rathnew, Clonmannon	1·40	36	...
,,	Balquhidder, Stronvar.	1·59	40	22	*Cars.*	Hacketstown Rectory	1·76	45	59
,,	Crieff, Strathearn Hyd.	·91	23	26	*QCo.*	Blandsfort House	1·50	38	56
,,	Blair Castle Gardens	1·38	35	...	,,	Mountmellick	·91	23	...
,,	Coupar Angus School	1·05	27	50	*KCo.*	Birr Castle	1·22	31	53
Forf.	Dundee, E. Necropolis	1·09	28	58	*Dubl.*	Dublin, FitzWm. Sq.	·81	21	43
,,	Pearsie House	1·95	49	...	,,	Balbriggan, Ardgillan	·48	12	24
,,	Montrose, Sunnyside	1·08	27	59	*Me'th*	Drogheda, Mornington	·44	11	...
Aber.	Braemar Bank	2·23	57	82	*W.M*	Mullingar, Belvedere	·97	25	35
,,	Logie Coldstone Sch.	2·03	52	98	*Long*	Castle Forbes Gdns.	1·82	46	64
,,	Aberdeen, Cranford Ho	2·14	54	92	*Gal*	Galway, Waterdale	1·31	33	...
,,	Fyvie Castle	2·60	66	...	*Mayo*	Crossmolina, Enniscoe	...	...	...
Mor	Gordon Castle	1·37	35	71	,,	Mallaranny	2·77	70	...
,,	Grantown-on-Spey	3·08	78	145	,,	Westport House	2·10	53	53
Na	Nairn, Delnies	1·26	32	70	,,	Delphi Lodge	3·79	96	...
Inv.	Ben Alder Lodge	...	...	...	*Sligo*	Markree Obsy.	2·86	73	83
,,	Kingussie, The Birches	1·75	44	...	*Ferm*	Enniskillen, Portora	1·88	48	...
,,	Fort Augustus	1·59	40	38	*Arm.*	Armagh Obsy.	...	...	...
,,	Loch Quoich, Loan	9·60	244	...	*Down*	Warrenpoint	1·50	38	...
,,	Glenquoich	8·35	212	81	,,	Seaforde	1·24	31	41
,,	Inverness, Culduthel R.	1·11	28	...	,,	Donaghadee	·98	25	43
,,	Arisaig, Faire-na-Squir	...	...	...	,,	Banbridge, Milltown	1·16	29	56
,,	Fort William	2·82	72	38	*Antr.*	Belfast, Cavehill Rd.	1·16	29	...
,,	Skye, Dunvegan	2·76	70	...	,,	Glenarm Castle	1·92	49	...
,,	Barra, Castlebay	1·87	47	...	,,	Ballymena, Harryville	1·93	49	60
R&C	Alness, Ardross Cas.	2·63	67	80	*Lon*	Londonderry, Creggan	2·29	58	72
,,	Ullapool	4·00	101	...	*Tyr*	Donaghmore	1·51	38	...
,,	Torridon, Bendamph	5·40	137	68	,,	Omagh, Edenfel	2·53	64	85
,,	L. Carron, Plockton	3·43	87	...	*Don*	Malin Head	1·60	41	66
,,	Stornoway	3·04	77	68	,,	Rathmullen	2·00	51	...
Suth.	Dunrobin Castle	...	...	...	,,	Dunfanaghy	2·48	63	70
,,	Lairg	3·92	100	...	,,	Narin, Kiltoorish	3·26	83	...
,,	Tongue Manse	3·21	81	92	,,	Killybegs, Rockmount	2·42	61	48

Climatological Table for the British Empire, September, 1923

STATIONS	PRESSURE		TEMPERATURE										PRECIPITATION			BRIGHT SUNSHINE	
	Mean of Day M.S.L.	Diff. from Normal	Absolute		Mean Values				Mean	Relative Humidity	Mean Cloud Am'nt	Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
			Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.							
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	mm.	mm.			
London, Kew Obsy.	1016·0	− 1·4	73	41	65·1	47·5	56·3	− 0·8	52·9	79	5·6	35	− 13	12	5·8	46
Gibraltar	1019·2	+ 3·4	84	54	75·5	64·8	70·1	− 2·1	64·7	75	5·0	35	− 1	6	...	...
Malta	1018·4	+ 2·7	87	66	79·4	70·8	75·1	− 0·1	69·3	73	3·5	13	− 17	2	...	...
Sierra Leone	1012·8	+ 0·2	88	70	84·4	72·5	78·5	− 0·7	74·3	81	7·3	628	− 97	27	...	...
Lagos, Nigeria	1012·3	− 0·5	86	70	83·5	73·6	78·5	+ 0·4	74·9	80	8·2	80	− 50	11	...	...
Kaduna, Nigeria	1015·5	+ 2·7	89	...	83·2	...	...	...	69·6	77	2·2	229	− 31	22	...	...
Zomba, Nyasaland	1013 4	− 0·4	89	52	82·2	59·3	70·7	+ 1·6	...	77	1·3	trace	− 9	1	...	...
Salisbury, Rhodesia	1014·6	− 0·1	92	41	83·0	49·9	66·5	+ 0·3	56·2	51	1·8	0	− 8	0	...	...
Cape Town	1019·4	+ 0·3	75	43	65·4	50·2	57·8	− 0·1	55·0	77	5·4	47	− 10	11	...	...
Johannesburg	1016·9	+ 0·5	89	38	74·7	50·1	62·4	+ 3·1	47·5	46	1·2	13	− 11	3	10·0	84
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1005·5	+ 1·0	92	77	89·9	78·7	84·3	+ 1·3	79·4	86	6·4	133	−130	*8	...	...
Bombay	1007·1	− 0·9	87	73	85·0	76·8	80·9	+ 0·2	75·9	85	7·1	465	+190	*13	...	...
Madras	1005·8	− 0·7	101	71	94·2	76·8	85·5	+ 0·4	75·4	70	5·6	82	− 49	*6	...	...
Colombo, Ceylon	1009·8	+ 0·2	87	73	85·1	76·0	80·5	− 0·9	77·0	76	8·6	346	+220	24	4·7	39
Hong Kong	1008·2	− 0·1	90	73	85·9	77·3	81·6	+ 0·6	74·8	73	5·5	160	− 86	15	8·2	67
Sandakan	...	...	91	73	88·1	75·1	81·6	− 0·1	†76·6	†76	...	85	−154	11	...	...
Sydney	1008·8	− 7·2	86	44	70·3	50·9	60·6	+ 1·6	52·5	58	3·6	56	− 18	11	7·6	64
Melbourne	1008·4	− 7·4	74	37	60·9	45·2	53·1	− 1·0	49·4	69	6·0	58	− 3	21	5·0	37
Adelaide	1011·5	− 6·0	79	38	65·2	46·9	56·1	− 0·9	50·6	67	5·7	148	+ 98	14	6·3	54
Perth, W. Australia	1016·7	− 1·2	68	45	63·4	49·4	56·4	− 1·7	52·1	74	6·4	199	+114	21	5·8	49
Coolgardie	1014·7	− 2·4	86	36	69·6	44·7	57·1	− 1·5	50·1	42	3·7	3	− 12	4	...	...
Brisbane	1012·7	− 4·4	92	48	77·6	54·5	66·1	+ 0·8	59·1	53	2·0	31	− 21	4	9·4	79
Hobart, Tasmania	1002·7	− 8·0	67	35	58·3	43·0	50·7	− 0·1	45·7	67	6·6	78	+ 24	24	5·5	47
Wellington, N.Z.	1014·0	+ 0·5	65	35	58·8	46·0	52·4	+ 0·9	48·8	76	7·0	56	− 43	10	5·0	43
Suva, Fiji	1013·6	− 0·7	83	62	77·8	66·5	72·1	− 2·4	68·5	76	6·9	140	− 37	18	...	...
Kingston, Jamaica	1012·5	− 0·1	96	71	92·6	74·0	83·3	+ 1·8	...	65	5·0	3	−101	5	...	...
Grenada, W.I.	1013·1	+ 1·3	89	70	85·7	74·9	80·3	+ 0·1	75·9	76	4·2	118	− 87	21	...	...
Toronto	1018·9	+ 1·1	85	37	69·3	52·0	60·7	+ 1·5	54·3	78	4·3	68	− 13	12	...	...
Winnipeg	1014·3	− 0·5	87	27	70·7	47·0	58·9	+ 5·5	52·0	73	3·5	28	− 22	10	...	...
St. John, N.B.	1019·0	+ 1·5	73	41	62·5	48·0	55·3	− 0·6	51·1	83	5·5	67	− 28	8	...	...
Victoria, B.C.	1017·6	+ 1·1	81	45	66·5	50·2	58·3	+ 2·7	53·7	81	2·9	37	− 14	5	...	...

* For Indian stations a rain day is a day on which 0·1 in. [illegible] or more rain has fallen. † Mean of observations at [illegible] 15h., 21h., from April, [illegible]

* For Indian stations a rain day is a day on which 0·1 in. [illegible] more rain has fallen. † Mean of observations at [illegible] 15h., 21h., from April, [illegible]